L4: Entry 14 of 26 File: USPT Jul 24, 2001

DOCUMENT-IDENTIFIER: US 6265298 B1
TITLE: Method for forming inter-metal dielectrics

Abstract Text (1):
An improved method for forming inter-metal dielectrics (IMD) over a semiconductor substrate is provided, wherein a conductive line is formed thereon. A first dielectric layer is formed over the conductive line. A second dielectric layer is formed on the first dielectric layer by a spin-on glass method. A curing treatment with an electron beam having a low energy and a high dosage is performed to cure an upper portion of the second dielectric layer so that a cured third dielectric layer is formed on the second dielectric layer. A fourth dielectric layer is formed on the cured third dielectric layer. A chemical-mechanical polishing process is performed using the cured dielectric layer as a stop layer. A cap layer is formed on the fourth dielectric layer.

Brief Summary Text (6):
In general, a spin-on glass (SOG) method is used in metal interconnects fabrication. The method includes coating SOG material on a wafer. Then a curing treatment is performed, in which the unwanted solvent of the SOG material is removed at a high temperature by a thermal treatment to cure the SOG material. Thus, a SOG layer is formed. The SOG material has better step coverage ability and better gap filling ability, therefore, the voids between the metal layers can be easily filled. In SOG application, a sandwich-type structure is provided, in which a dielectric layer made of SOG material is formed between two silicon oxide layers formed by chemical vapor deposition (CVD). Thus, the properties of the SOG layer such as dielectric constant cannot be affected in a subsequent process.

Brief Summary Text (16):
To achieve these and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, the invention provides a method for forming inter-metal dielectrics (IMD) over a semiconductor substrate, wherein a conductive line is formed thereon. A first dielectric layer is formed over the conductive line. A second dielectric layer is formed on the first dielectric layer by a spin-on glass method. A curing treatment with an electron beam having a low energy and a high dosage is performed to cure an upper portion of the second dielectric layer so that a cured third dielectric layer is formed on the second dielectric layer. A fourth dielectric layer is formed on the cured third dielectric layer. A chemical-mechanical polishing process is performed using the cured dielectric layer as a stop layer. A cap layer is formed on the fourth dielectric layer.

Detailed Description Text (6):
As shown in FIG. 2B, a curing treatment is performed. The substrate 21 is exposed with a low-energy, high-dosage electron beam. In one preferred embodiment for performing the present method, the energy level of the electron beam is from about 2 KeV to about 4 KeV and the dosage level thereof is from about 8000 c/cm.sup.2 to about 10000 c/cm.sup.2. During electron beam exposure, an upper portion of the SOG layer 24 (FIG. 2A) is cured and converted into a cured SOG layer 24' which is like a thermal oxide on the surface of the SOG layer 24. At the same time, a lower portion 24" of the SOG layer 24 is not cured by the electron beam. In case that floatable oxide is used as the SOG material, the cured dielectric layer 24' will include hydrogen bonds, but has the same property as thermal oxide. In performance of the